Instruction Manual Number 0101-8881-0

AIRCO Temescal

Model LC-1
Liquid Nitrogen Level Control

(Part Number 0505-0253-3)

MP MASTER
MA32750

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Terms and Conditions

MECHANICAL WARRANTY: For a period of twelve (12) months from the date of original shipment to Purchaser thereof, the apparatus and each part or component manufactured by the Airco Temescal Division of Airco, Inc. ("Airco") is warranted to be free from functional defects in materials and workmanship. The foregoing warranty is subject to the condition that the apparatus, part or component be properly operated under conditions of normal use and that regular periodic maintenance and service be performed or replacements made in accordance with instructions provided by Airco. The foregoing warranty shall not apply to any apparatus, part or component that has been repaired other than by Airco or an authorized Airco representative or in accordance with written instructions provided by Airco, that has been altered by anyone other than Airco or that has been subject to improper installation or abuse, misuse, negligence, accident or corrosion.

Purchaser's sole and exclusive remedy under the above warranty is limited to, at Airco's option, repair or replacement of defective parts or components or return to Purchaser of the price of the apparatus. Any such obligation on Airco's part is subject to the following requirements: (x) the defect must be promptly reported to Airco; (y) if so advised by Airco, Purchaser must return the part or component with a statement of the observed deficiency not later than seven (7) days after the expiration date of the warranty to the address designated by Airco, during normal business hours, transportation charges prepaid; and (z) upon examination by Airco, the part or component must be found not to comply with the above warranty. Return trip transportation charges for the part or component shall be paid by Purchaser. In the event that Airco elects to refund the purchase price, the apparatus shall be the property of Airco and shall be promptly shipped to Airco at Airco's expense. This Mechanical Warranty shall be void and the apparatus shall be deemed to be purchased AS IS in the event that the entire purchase price has not been paid within thirty (30) days of original shipment of the apparatus.

THERE ARE NO EXPRESS OR IMPLIED WARRANTIES THAT EXTEND BEYOND THE WARRANTY HEREINABOVE SET FORTH. THERE IS NO WARRANTY OF MERCHANTABILITY OR FITNESS FOR A PARTICULAR PURPOSE WITH RESPECT TO THE APPARATUS OR ANY PART OR COMPONENT THEREOF AND NO WARRANTY SHALL BE IMPLIED BY LAW.

Items not of Airco's manufacture but resold by Airco are the products of other manufacturers and their warranty, if any, shall apply. THERE ARE NO WARRANTIES OF ANY KIND ON PRODUCTS OF OTHER MANUFACTURERS RESOLD BY AIRCO, EXCEPT THE WARRANTY OF TITLE, AND NO WARRANTIES SHALL BE IMPLIED BY LAW. THERE IS NO EXPRESS OR IMPLIED WARRANTY OF MERCHANTABILITY OR OF FITNESS FOR A PARTICULAR PURPOSE WITH RESPECT TO PRODUCTS OF OTHER MANUFACTURERS.

PERFORMANCE WARRANTY: Airco warrants that the apparatus will comply with the specifications set forth in the purchase order. All specifications are subject to the corrections and tolerances allowed by the NEC. If the purchase order expressly provides for factory testing to verify compliance with the specifications, the Purchaser shall be entitled to witness the testing and the results of the testing. Upon demonstration of compliance with the specifications by factory testing, Airco's liability for failure to comply with the specifications shall terminate. In the event that the purchase order does not describe a comprehensive test program for demonstration of compliance with the specifications, Airco's test program (which may incorporate extrapolation of data or test results based upon similarity of criteria established by Airco) shall be used for such purpose.

If the purchase order does not expressly provide for factory testing, compliance with the specifications shall be demonstrated by field testing which shall be conducted by Purchaser at Purchaser's expense. Airco shall have the right to: (a) witness the field testing and to verify the results of such field testing; (b) have free access to all data compiled by the Purchaser in connection with any field test; and (c) conduct its own field test at its own expense during any 14-day consecutive period which may be mutually agreed upon by Airco and the Purchaser; provided, however, that Airco shall have the right to field test within six months of receipt from the Purchaser of any notice of failure to comply with the specifications. If compliance with the specifications is to be demonstrated by field testing, the Purchaser shall conduct and complete all field testing within sixty (60) days of the original shipment of the apparatus and shall promptly notify Airco of any failure to comply with the specifications. Airco shall not be liable for any failure to comply with the specifications demonstrated by field testing unless it receives notice thereof within sixty-seven (67) days of the date of original shipment of the apparatus.

In the event that factory testing or field testing does not demonstrate compliance with the specifications, the Purchaser's sole and exclusive remedy under the above warranty is limited to, at Airco's option, repair or replacement of defective parts or components or return to the Purchaser of the purchase price of the apparatus. In the event that Airco elects to refund the purchase price, the apparatus shall be the property of Airco.

Any obligations on Airco's part under this Performance Warranty are subject to the following re-

quirements: (x) the nature of the failure of the apparatus to comply with the specifications must be promptly reported to Airco in writing; (y) if the apparatus has been delivered and field tested, the Purchaser must return the apparatus or any part or component to Airco upon its request, not later than sixty-seven (67) days after initial shipment to Purchaser, to the address designated by Airco, during normal business hours, transportation charges prepaid; and (z) upon examination and testing by Airco, the apparatus must be found not to comply with the specifications. Return trip transportation charges for the apparatus or any part or component shall be paid by the Purchaser. This Performance Warranty shall be void and the apparatus shall be deemed to be purchased AS IS in the event that the entire purchase price has not been paid within thirty (30) days of original shipment of the apparatus.

THERE ARE NO EXPRESS OR IMPLIED WARRANTIES THAT EXTEND BEYOND THE WARRANTY HEREINABOVE SET FORTH. THERE IS NO WARRANTY OF MERCHANTABILITY OR FITNESS FOR A PARTICULAR PURPOSE WITH RESPECT TO THE APPARATUS OR ANY PART OR COMPONENT THEREOF AND NO WARRANTY SHALL BE IMPLIED BY LAW.

DISCLAIMER OF LIABILITY: IN NO EVENT SHALL AIRCO BE LIABLE FOR DIRECT, INDIRECT, SPECIAL, INCIDENTAL, OR CONSEQUENTIAL DAMAGES, ARISING FROM ANY SOURCE such as, but not limited to, the manufacture, use, delivery (including late delivery) or transportation of any apparatus, part or component sold to Purchaser, whether such damages are caused by Airco's negligence or otherwise. Without limiting the generality of the foregoing sentence, Airco shall not be liable for: the cost of capital; the cost of substitute apparatus, services, repairs, components or parts; loss of profit or revenue; the cost of power whether purchased or produced by the consumer thereof; loss of use of the apparatus or any part thereof, or any other property owned by Purchaser; claims or costs of Purchaser's customers; injury to persons or death; or damages to any property. In the event that any limited warranty or disclaimer of liability is found to be unlawful or inapplicable, or to have failed of its essential purpose, Airco's liability shall be limited to the amount paid by Purchaser for the apparatus.

USER RESPONSIBILITY

This equipment will perform in accordance with the instructions and information contained in this manual and its referenced documents when such equipment is installed, operated, and maintained in compliance with such instructions. The equipment must be checked periodically. Defective equipment shall not be used. Parts that are broken, missing, plainly worn, distorted, or contaminated, shall be replaced immediately. Should such repair or replacement become necessary, Airco recommends that a telephonic or written request for service be made to Airco Temescal.

The equipment, or any of its parts, shall not be altered without the prior written approval of Airco Temescal. The user and/or purchaser of this equipment shall have the sole responsibility for any malfunction which results from improper use, faulty maintenance, damage, improper repair or alteration by any party other than Airco Temescal.

SECTION 1

DESCRIPTION AND SPECIFICATIONS

1.1 GENERAL DESCRIPTION

The Model LC-1 Liquid Nitrogen Level Controller is designed to automatically maintain the level of liquid nitrogen in a vacuum dewar, cold trap, or other cryogenic reservoir. A sensor installed in the reservoir signals the control circuit when liquid nitrogen falls below the desired level. The circuit in turn provides 115V ac to energize a (customer-provided) solenoid valve which is normally closed. When the valve opens, liquid nitrogen flows into the reservoir for a period of time (one to six minutes) which is determined by a timer setting on the front panel of the controller.

1.2 SPECIFICATIONS

Sensor:	7/32-inch O.D. x 5/8-inch long (Solid State, encapsulated)
Sensor Lead:	8 feet long (two Teflon-insulated, stranded conductors with fiberglass jacket)
Power Requirements:	115V ac, 60 Hz nominal (working range is 105/125V, 50/60 Hz)
Power Consumption:	10 watts maximum, excluding solenoid output
Fuse:	3 ampere, type AGC
Timer Tolerance:	+1.5 minutes, -1 minute; repeatability 0.5 minute
Housing Material:	Aluminum
Dimensions:	Height, 3 inches (76 mm)
	Width, 8 inches (205 mm)
	Depth, 4 inches (102 mm)

SECTION 2

INSTALLATION

Installation procedure is as follows:

a) Install the sensor in the LN_2 reservoir.

b) Connect the power cord to a 115V ac, 60 Hz outlet.

c) Connect the solenoid output (located on the rear panel) to a 115V ac, 60 Hz, normally-closed solenoid valve.

Two typical installations are shown in Figure 1.

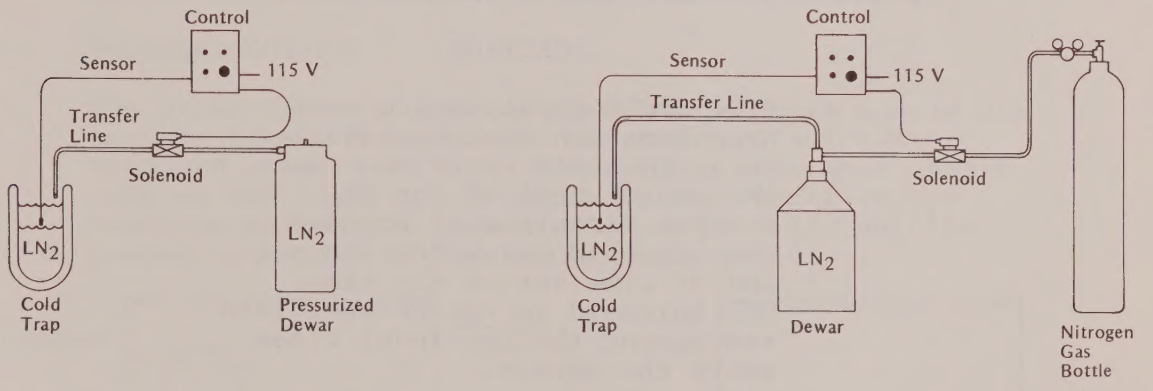

Figure 1 Typical Installations of the Model LC-1 Liquid Nitrogen Level Controller

SECTION 3

OPERATION

3.1 AUTO/OFF/MAN SWITCH

When this switch is in the AUTO position, the controller will maintain the liquid nitrogen level as described in paragraph 1.1. In the OFF position, power is off throughout the circuit. In the MAN position, power is supplied to the valve solenoid regardless of sensor condition. In other words, setting this switch at MAN is equivalent to opening the valve.

3.2 TIMER KNOB

This knob controls the duration of the fill cycle. It is adjustable from 0 to 6 minutes.

CAUTION

Fill cycle duration and sensor head location must be adjusted so as to avoid overflow. Once the sensor "calls" for LN_2, the control circuit will actuate the solenoid valve for the period of time set on the timer. The solenoid is not de-energized the moment the LN_2 level rises above the sensor.

3.3 PRINCIPLES OF OPERATION

The basic components in the level detection circuit are a thermistor type sensor, solid state switch (triac), and relay load. In liquid nitrogen, the sensor resistance is high and prevents the triac from triggering on. As the sensor comes out of the liquid into the gas phase nitrogen, the resistance lowers due to the self heat imposed on the sensor (2 milliwatts nominal for standard sensor). The triac is consequently triggered, energizing the relay load.

The LC-1 has one level control circuit. When in the automatic mode of operation, the circuit operates as follows: As the liquid level decreases below the sensor, the solenoid output is energized, providing 115V ac at the rear for solenoid actuation. As the liquid level increases above the sensor, the internal solid state timer is initiated. At the end of the time cycle, the solenoid output is de-energized. The frequency of valve actuation depends on the LN_2 depletion rate and the timer setting.

SECTION 4

MAINTENANCE AND TROUBLESHOOTING

4.1 MAINTENANCE

No periodic maintenance is required for the LC-1.

4.2 TROUBLESHOOTING

The triac circuit used in the LC-1 is quite simple and trouble-free. However, in the event of a failure, standard electrical troubleshooting techniques should suffice for finding the exact cause. Oscilloscope readings across the sensor (Figure 2) will indicate proper operation of the solid state triac.

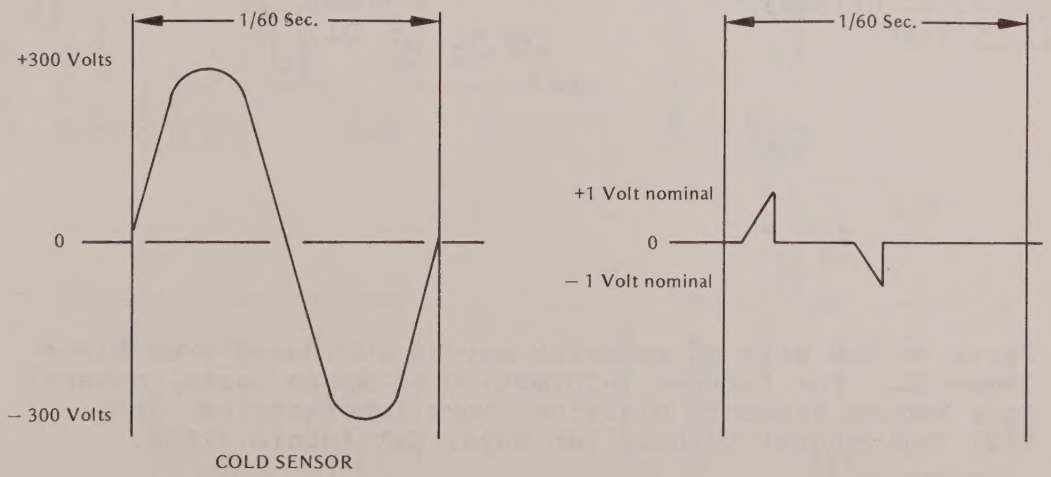

Figure 2 Normal Waveforms Across the LC-1 Sensor Head

SECTION 5

SPARE PARTS

Qty.	Description	Reference	Part No.
1	Sensor*		9999-0021-2
1	Circuit Module*		9999-0021-1
2	Relay, 110V dc	K1,K2	
2	Capacitor, 0.01 mfd	C2,C5	
2	Diode, F-6	CR1,CR2	
3	Resistor, 470 ohm, 1/4 watt	R2,R4,R10	
2	Resistor, 75 ohm	R3,R5	
1	Resistor, 3,000 ohm, 20 watt	R1	
1	Capacitor, 100 mfd, 150V dc	C1	
2	Resistor, 120 ohm	R9,R11	
1	Capacitor, 0.1 mfd, 600 volt	C7	
1	Resistor, 10K ohm, 1/2 watt	R6	
1	Resistor, 15K ohm, 1 watt	R7	
1	Trimmer Pot, 10K ohm	R8	
1	Capacitor, 0.1 mfd, 200 volt	C6	
1	Capacitor, 4 mfd, 250V dc	CR3	
1	Capacitor, 50 mfd, 50V dc	C4	
1	Diode, TI-53	CR3	
1	Transistor, TIS-43	Q2	
1	SCR, GE106B2	VR1	
1	Triac	Q1	

* Parts marked with an asterisk may be purchased from Airco Temescal. For further information on spare parts, contact: Torr Vacuum Products Division, Torr Laboratories, Inc., 7121 Hayvenhurst Avenue, Van Nuys, California 91406.

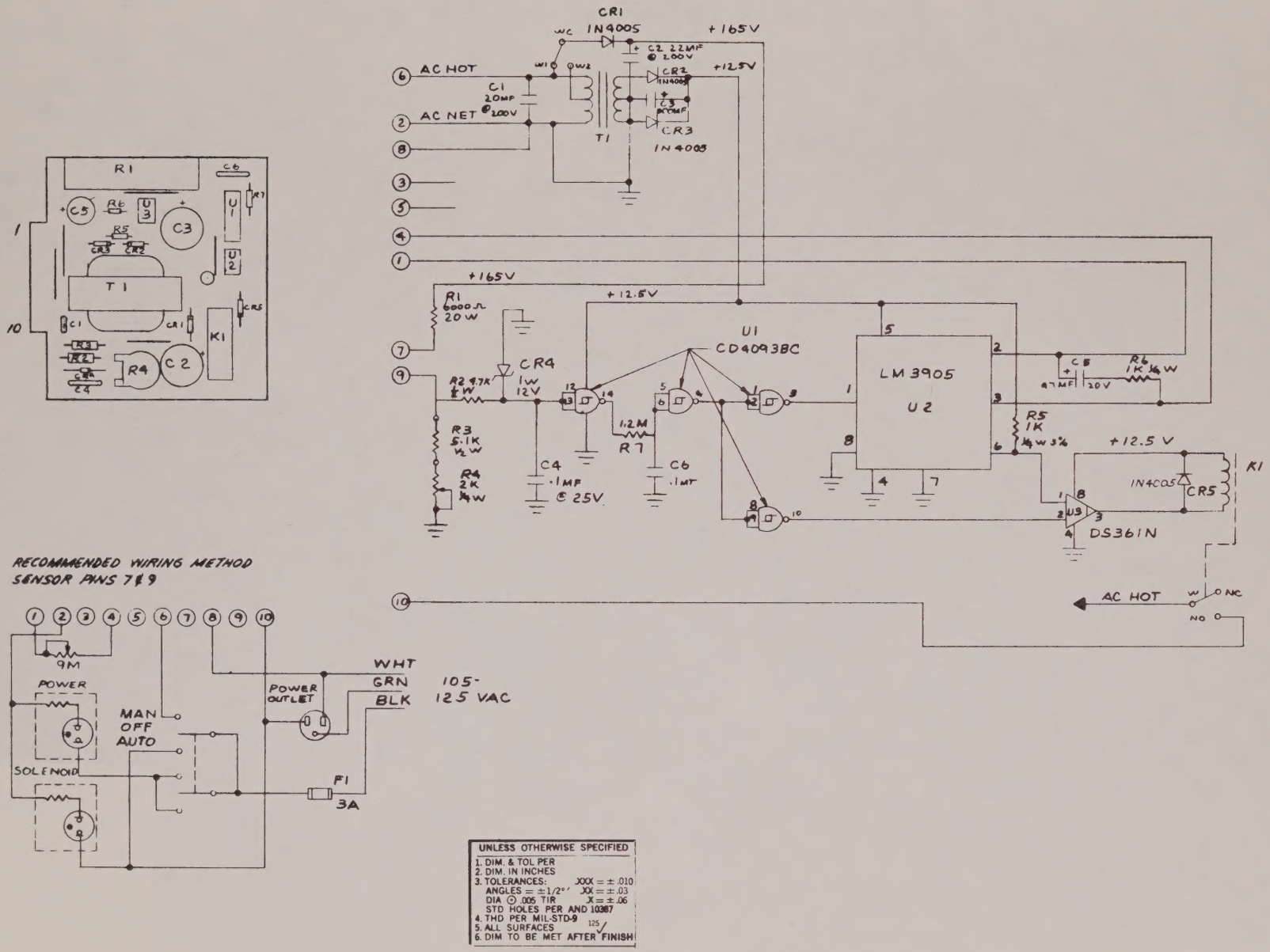

Figure 3a Model LC-1 Wiring and Assembly Diagram
(serial number 8932 and following)

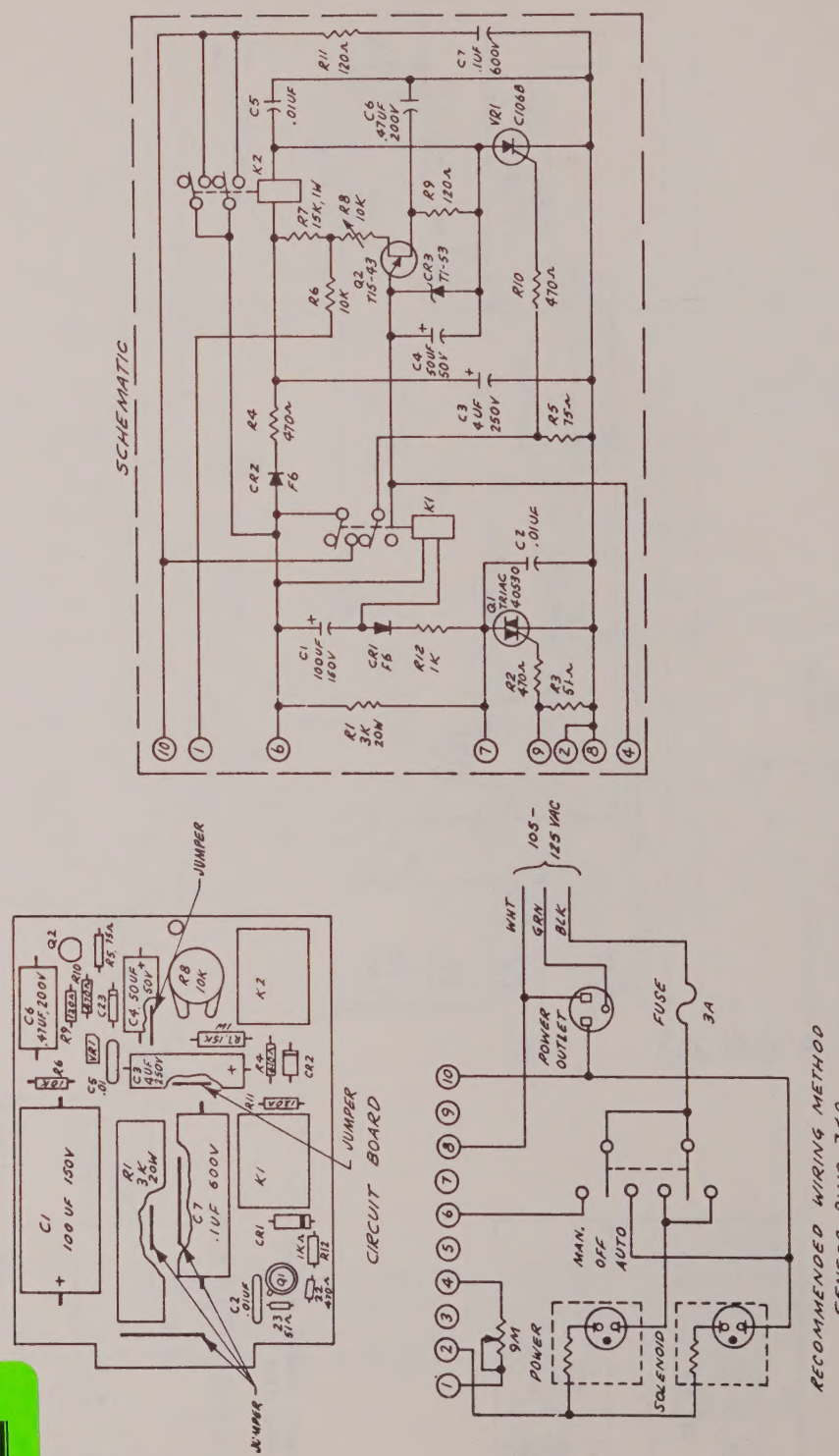

Figure 3b Model LC-1 Wiring and Assembly Diagram (serial numbers before 8932)

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